

THE MINERAL INDUSTRY OF NORWAY

By Chin S. Kuo

Oil was the main source of income for Norway, which was the third ranked oil exporter after Saudi Arabia and Russia. Norway also produced vast amounts of natural gas from its offshore fields. In 2004, crude oil output was 3.2 million barrels per day, and gas sales amounted to 78 billion cubic meters. Fossil fuel made up 22.6% of Norway's gross domestic product (GDP) at purchasing power parity and 41.5% of its exports. The GDP growth was 2.9% compared with that of 0.4% for 2003. The country achieved the second highest living standard after Luxembourg in Europe with a per capita GDP at purchasing power parity of \$40,005. The inflation rate was low at 0.4% (International Monetary Fund, 2005¹).

In addition to its rich oil and gas resources, Norway has hydroelectric power and nonferrous metals. Hydroelectricity powers the country's manufacturing and mineral-processing industries. Exploration for base metals (copper, nickel, and zinc) and gold was active in 2004. Licenses for exploratory drilling and production were issued by the Government for blocks in the Barents, the North, and the Norwegian Seas.

In June, Norwegian oil workers walked out for a week, which shut down offshore production platforms in Statoil ASA's Snorre and Vigdis fields; loss of production was 455,000 barrels per day (bbl/d), or about 15% of the country's oil output. The unions intended to cut Norway's oil production and to disrupt natural gas exports to the United Kingdom (Washington Post, The, 2004).

Government Policies and Programs

The Government completed the sale of its shares in Statoil, which reduced its interest to 76.3%. The sale of shares for \$162 million to private investors was the latest step in Norway's 3-year program of the partial privatization of Statoil. Under the privatization plan, Government ownership would be reduced to 66%. Statoil employed about 19,000 workers, 40% of them outside Norway (Alexander's Gas & Oil Connections, 2004b§).

Commodity Review

Metals

Aluminum.—Alcoa Inc. of the United States planned to invest \$314 million in a new anode plant to be built as a joint venture with Elkem A/S at Mosjoen. The facility would produce anodes for Alcoa's Fjardal aluminum smelter in Iceland and the Mosjoen smelter in Norway, which was 50% owned by Alcoa and Elkem. Construction of the anode plant was expected to be completed by 2007. The Fjardal smelter was scheduled to come onstream the same year. Anodes used at the Mosjoen smelter were purchased by Elkem (Platts, 2004§).

Norsk Hydro A/S was considering cutting the workforce at its Norwegian aluminum smelters by 25% to reduce the operating costs by \$51 million to \$66 million per year. The company employed 3,400 workers at its Norwegian metals operations. The job reductions at Ardal and Hoyanger would be completed by the end of 2006 because the company had to close its potlines that used outdated Soderberg alumina reduction technology to comply with environmental legislation (Mining Journal, 2004a).

Norsk Hydro commissioned the final 90,000-metric-ton-per-year (t/yr) phase of the \$837 million expansion at its Sunndal aluminum smelter. The capacity was increased to 360,000 t/yr. The first of the 116 cells in the phase went into operation in June; the remaining cells became operational during the last quarter of 2004 (Mining Journal, 2004b).

Ferroalloys.—FESIL ASA continued operating two of its three plants at full capacity in 2004. The company had capacities of 110,000 t/yr of ferrosilicon at its Rana plant and 50,000 t/yr of silicon metal at its Holla plant; production capacity at its mothballed Lilleby ferrosilicon plant was 20,000 t/yr. World output of ferrosilicon was around 4 million metric tons per year (Mt/yr), and that of silicon metal was slightly more than 1 Mt/yr (Reuters, 2004§).

Gold.—Kenor/Guinar Gold Corp. of the United Kingdom and Scanmining AB of Sweden planned a program of drilling for gold and zinc at the Gjedde Lake and the Kobbfors concessions at Pasvikdalen, northern Norway. The drilling was carried out by Scanor Mining AS, which was a 50/50 joint venture between the two companies, and was expected to be completed during the first half of 2004. A permit for further work to verify tonnage and grade will be sought in the second half (Guinar Gold Corp., 2004).

Nickel.—Blackstone Ventures Inc. of Canada obtained results of a 121-line-kilometer ground geophysical survey on the approximately 50-square-kilometer Espedalen nickel-copper-cobalt property in central Norway that would allow precise targeting for drill testing of the conductors, which were interpreted to be nickel-bearing sulfide zones. A 3,500-meter (m) drill program to test the highest priority conductors was planned in July 2004. The company had an option to earn a 60% interest in the property from Sulfidmalm A/S (a subsidiary of Falconbridge Ltd. of Canada) by spending \$1.5 million for exploration in 2004. Falconbridge made a private placement in Blackstone Ventures for \$375,000 (Blackstone Ventures Inc., 2004b).

In addition to the Espedalen property, a 3,650-line-kilometer airborne electromagnetic (EM) and magnetometer survey was completed on the Vakkerlien property in central Norway. A 300-m-long EM anomaly was detected at the Olkar showing, a 500-m-

¹References that include a section mark (§) are found in the Internet References Cited section.

long EM anomaly was detected at the northern end, and two 600-m-long anomalies were detected along the eastern margin of the Kletten peridotite (Blackstone Ventures Inc., 2004a).

Diamond Fields International Ltd. of Canada acquired the Ognå nickel-copper project, which consisted of the Bjørndalsnipa and the Gulldragvatn properties in southwestern Norway. The company planned a drilling exploration program that would begin in mid-May. The oldest massif of the Rogaland Intrusive Massifs, Ognå-Egersund, hosted several nickel-copper occurrences. The company would concentrate its drilling on the geophysical anomalies Bjørndalsnipa (nickel-copper mineralization) and Gulldragvatn (nickel-copper-titanium mineralization) (Diamond Fields International Ltd., 2004).

Mineral Fuels

The Government reopened the Barents Sea for exploratory drilling. The decision was a compromise between the call for more jobs in the north and the demand for measures to protect the environment. Environmental organizations protested against any drilling in the region. Norwegian oil companies planned to drill four new exploratory wells. New areas for exploration were released around the Snøehvit Field and Goliat. Meanwhile, Norway's 18th licensing round acreage contained 95 blocks or partial blocks in the frontier areas of the North and the Norwegian Seas. Deadline for submission of applications was March 15, 2004 (Alexander's Gas & Oil Connections, 2004d§).

The Government offered 28 oil and gas production licenses on the country's continental shelf to 21 local and international energy companies. The licenses were for development of offshore oil and gas reserves that had reached maturity in specified areas of the Barents, the North, and the Norwegian Seas. After receiving proposals from a number of companies for operations in the zones, the Government offered full operatorship licenses and participating stakes (Alexander's Gas & Oil Connections, 2004a§).

Norsk Hydro Produksjon A/S planned to develop its Klegg oil discovery, which had been made in 2003. The discovery was located between Heimdal and Vale and held 120 million barrels (Mbbbl), although only 30 to 60 Mbbbl was recoverable. Production was expected to start in 2006. Interests in the discovery were Norsk Hydro Produksjon as operator (28.5%), Marathon Oil Corporation (46.9%), Total SA (24.2%), and The J.J. Ugland Companies (0.3%) (Petroleum Economist, 2004a).

Statoil's first production well at Haltenbanken in the Kristin Field found a second reservoir below the main one; both were at depths of 5 kilometers (km). The find might increase the recoverable reserves by between 5% and 10%. Statoil owned 47% of the Kristin Field; other owners were ENI S. p. A., Exxon Mobil Corp., Norsk Hydro Produksjon, Petoro AS, and Total. The development of the field was expected to be completed in March 2005 (Alexander's Gas & Oil Connections, 2004c§).

Statoil planned a \$258 million program to increase oil recovery by 26 Mbbbl from one of the three fields under the Asgard license in the Norwegian Sea. FMC Technologies of the United States would supply subsea production systems, and Transocean Offshore Inc.'s drilling rig drilled two wells, spudding the first in April. Production was scheduled to begin in early 2005. Another two production wells that would cost \$258 million were planned (Oil & Gas Journal, 2004a).

The reserves of Statoil's Mikkjel Gasfield in the Norwegian Sea were estimated to be 28 billion cubic meters of gas and 40 Mbbbl of condensate. Production started on October 1, 2003, and the field produced 5.8 million cubic meters per day of gas in 2004. Its well stream was piped to subsea installations before being transported to the Royal Dutch/Shell Group-operated Asgard B production platform. Following separation, the gas was piped through the Asgard trunkline to the processing complex at Karsto, which is located north of Stavanger (Oil & Gas Journal, 2004b).

Statoil and its partners planned to develop and operate the Norne satellite fields, Staer and Svale, with an investment of \$509 million. The satellites would be brought onstream to the Norne production ship in October 2005; this would raise output through the vessel by 700,000 bbl/d and extend Norne's life by 2 years (Petroleum Economist, 2004b).

Total began production from Skirre natural gas and condensate field on Block 25/5 in the Norwegian sector of the North Sea; the block is located 140 km northwest of Stavanger. The field consisted of two subsea wells, Byggve and Skime, which were tied back to the Heimdal platform. Total expected production to be 4.25 million cubic meters per day of gas and 6,900 bbl/d of condensate. Total was the operator and held a 40% interest in the field with Petoro (30%), Marathon Petroleum Norge AS (20%), and Norsk Hydro Produksjon (10%) (Oil & Gas Journal, 2004c).

Norsk Hydro Produksjon submitted a plan for development and operation of its Ormen Lange Gasfield in the North Sea. The field would produce from subsea installations with gas landed to a terminal to be built at Nyhamna. Gas would be exported at 20 billion cubic meters per year from the terminal via Slepner to the United Kingdom's Easington terminal through a 1,200-km pipeline. The cost of the development was estimated to be \$10 billion. The field was expected to come onstream in 2007. FMC Kongsberg Subsea won Norsk Hydro Produksjon's \$152 million contract for the subsea production system for Ormen Lange. The field had reserves of 234 million barrels of oil equivalent (Petroleum Economist, 2004a).

Of the seven licensees in the Snøehvit field in the Barents Sea, Statoil (22.3%), Norsk Hydro Produksjon (10%), RWE-DEA, Amerada Hess Corp., and Svenska Petroleum Exploration AB signed separate contracts for the sale of liquefied natural gas to El Paso Global LNG Co., which would buy 2.4 billion cubic meters per year, and Iberdrola SA, which would buy 1.6 billion cubic meters per year. The remaining licensees—Total (22.3%) and Gaz de France (12%)—would use their own gas, which totaled 1.7 billion cubic meters per year. The Norwegian Government had a 30% interest in the field. Construction began on the first 4.2-Mt/yr train with deliveries scheduled for 2006 (Oil & Gas Journal, 2004d).

Statoil planned to build a cogeneration plant at the Mongstad refinery near Bergen and a gas-fired plant at Tjeldbergodden in central Norway. Total investment for the projects was approximately \$1.24 billion (Tjeldbergodden, \$800 million, and Mongstad, \$440 million). The cogeneration plant would be fueled with surplus gas supplied by the refinery and natural gas from the Troll A platform and would supply the refinery with power and heat, as well as deliver electricity to Troll and the gas-processing plant at Kollsnes. The 280-megawatt (MW) powerplant at the Mongstad refinery was expected to be completed in 2008. Gas would be piped to the 860-MW

Tjeldbergodden powerplant from Heidrun in the Norwegian Sea. Besides the internal power use, the remaining output would be delivered to the grid in central Norway. Startup of the powerplant was scheduled for 2008 (Statoil ASA, 2004).

Outlook

Although Norway's crude oil production has decreased gradually at an average of 3% per year from the mature fields, output of natural gas has increased steadily at a rate of 12% per year. The exploration and development projects that will be underway in the next 2 to 3 years are expected to boost oil production and to increase gas output substantially in the future.

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Major Sources of Information

Norwegian Geological Survey
P.O. Box 3006 Lade
7002 Trondheim, Norway

Royal Ministry of Petroleum and Energy
P.O. Box 8148 Dep
0033 Oslo, Norway

TABLE 1
NORWAY: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity	2000	2001	2002	2003	2004
METALS					
Aluminum:					
Primary	1,025,676	1,067,600 ^r	1,095,500	1,192,400	1,321,700
Secondary	254,600	223,900	271,000	256,800	348,700
Cadmium, smelter	298	372	209	331	260
Cobalt:					
Mine output, Co content ^c	100	100	100	-- ^r	--
Metal, refined	3,433	3,314	3,994	4,556	4,670
Copper, metal, refined, primary and secondary	27,000 ^e	26,700	30,500	35,900	35,600
Iron and steel:					
Iron ore and concentrate, Fe content thousand metric tons	369	340 ^e	350 ^e	340 ^r	408
Metal: do.					
Pig iron ^c do.	60	60	80	90	90
Ferroalloys: ^c					
Ferrochromium do.	154 ²	83 ²	61 ²	-- ^{r, 2}	-- ²
Ferromanganese do.	235	240	240	245	245
Ferrosilicomanganese do.	230	230	230	230	230
Ferrosilicon, 75% basis do.	460	450	390	350	300
Silicon metal do.	100	100	105	100	105
Other do.	15	15	15	15	15
Total do.	1,190	1,120	1,040	940 ^r	900
Steel, crude do.	620	635	694	698	695
Semimanufactures, rolled do.	573	623	630 ^e	635 ^e	640 ^e
Magnesium, primary	41,400	36,000 ^e	10,000 ^e	--	--
Nickel:					
Mine output:					
Concentrate ^c	18,000	18,000	12,000	--	--
Ni content	2,538	2,529	1,700	--	--
Metal, primary	58,679	68,220	68,500	77,200	71,400
Platinum-group metals ^{e, 5} kilograms	1,000	1,000	1,000	1,000	1,000
Titanium: ^c					
Ilmenite concentrate thousand metric tons	750	750	750	840 ^{r, 2}	860
TiO ₂ content do.	340	340	340	378 ^{r, 2}	387
Zinc, metal, primary	125,800	129,300	137,300	135,500	128,500
INDUSTRIAL MINERALS					
Cement, hydraulic ^c thousand metric tons	1,851 ²	1,870	1,850	1,860	1,870
Feldspar ^c	75,000	73,000	75,000	74,000	75,000
Graphite ^c	2,500	2,500	2,400	2,400	2,300
Lime, hydrated, quicklime ^c thousand metric tons	100	100	100	100	100
Mica, flake ^c	2,500	2,500	2,600	2,600	2,600
Nepheline, syenite ^c thousand metric tons	300	310	310	300	300
Nitrogen, N content of ammonia do.	334	323	330	354	420
Olivine sand ^c do.	3,200	3,300	3,200	3,100	3,100
Stone, crushed: ^c					
Dolomite	900	900	900	850	850
Limestone	7,000	7,500	7,400	7,200	7,300
Quartz and quartzite	1,300	1,500	1,400	1,500	1,500
Sulfur, byproduct:					
Metallurgical	92	105	102	100	100
Petroleum ^c	18	18	19 ^r	20 ^r	20
Total ^c	110	123	121 ^r	120 ^r	120
Talc, soapstone, steatite ^c	27	27	28	28	28

See footnotes at end of table.

TABLE 1--Continued
NORWAY: PRODUCTION OF MINERAL COMMODITIES¹

(Metric tons unless otherwise specified)

Commodity		2000	2001	2002	2003	2004
MINERAL FUELS AND RELATED MATERIALS						
Coal, all grades ^e	thousand metric tons	330	320	310	300	300
Gas, natural, marketed ⁴	million cubic meters	49,748 ^r	53,895 ^r	65,501 ^r	73,124 ^r	78,465
Peat, for agricultural use ^e	do.	30	30	30	30	30
Petroleum:						
Crude ⁵	thousand 42-gallon barrels	1,140,200 ^r	1,138,400 ^r	1,092,800 ^r	1,041,400 ^r	1,024,400
Natural gas liquids ^e	do.	41,000	41,000	41,000	42,000	42,000
Refinery products: ^e						
Naphtha	do.	26,000	27,000	27,000	27,000	28,000
Gasoline	do.	26,000	26,000	26,000	27,000	27,000
Kerosene	do.	9,000	9,000	9,000	9,000	9,000
Distillate fuel oil	do.	46,000	46,000	46,000	47,000	48,000
Residual fuel oil	do.	12,000	12,000	12,000	12,000	12,000
Other products	do.	4,000	4,500	5,000	5,000	5,500
Refinery fuel and losses	do.	4,000	4,000	5,000	5,000	4,500
Total	do.	127,000	129,000	130,000	132,000	134,000

^eEstimated; estimated data are rounded to no more than three significant digits; may not add to totals shown. ^rRevised. -- Zero.

¹Table includes data available through September 2, 2005.

²Reported figure.

³Data represent exports.

⁴Reported as total methane sales.

⁵Excluding natural gas liquids.

TABLE 2
NORWAY: STRUCTURE OF THE MINERAL INDUSTRY IN 2004

(Thousand metric tons unless otherwise specified)

Commodity	Major operating companies and major equity owners		Location of main facilities	Annual capacity
Aluminum	Hydro Aluminium ANS (Norsk Hydro A/S, 70%)		Smelters at Ardal, Hoyanger, Karmoy, and Sunndal	600
Do.	do.		Plant at Holmestrand	90
Do.	Elkem Aluminium ANS (Elkem A/S, 50%, and Alcoa Inc., 50%)		Smelters at Farsund and Mosjoen	250
Do.	Sor-Norge Aluminium A/S (Alusuisse Group, 50%, and Hydro Aluminium ANS, 49%)		Smelter at Odda	50
Cadmium	Norzink A/S (Outokumpu Oyj, 100%)		Smelter at Eitrheimsneset	0.3
Cement	Norcem A/S		Plants at Brevik and Kjøpsvik	2,150
Coal	Store Norske Spitsbergen Kulkompani A/S		Mines at Longyearbyen and Svea	450
Cobalt	Nikkelverk A/S (Falconbridge Nickel Mines Ltd., 100%)		Smelter at Kristiansand	3
Copper:				
Ore, Cu content	Nikkel og Olivin A/S (Outokumpu Oyj, 100%)		Mine at Narvik	1
Metal	Nikkelverk A/S (Falconbridge Nickel Ltd., 100%)		Smelter at Kristiansand	40
Dolomite	Franzefoss Bruk A/S		Mine at Ballagen	350
Do.	Norwegian Holding A/S		Mines at Hammerfall, Logavlen, and Kvitblikk	500
Feldspar	Franzefoss Bruk A/S		Mine at Lillesand	100
Ferroalloys	Elkem Salten (Elkem A/S, 100%)		Ferrosilicon plant at Straumen	90
Do.	Elkem Bjølvfossen (Elkem A/S, 100%)		Ferrosilicon plant at Alvik	60
Do.	Elkem Thamshavn (Elkem A/S, 100%)		Ferrosilicon plant at Orkanger	60
Do.	Finnfjord Smelteverk A/S, Rana Metal (FESIL ASA, 100%)		Ferrosilicon plant at Mo i Rana	110
Do.	A/S Hafslung Metal (FESIL ASA, 100%)		Ferrosilicon plant at Sarpsborg	75
Do.	Ila og Lilleby Smelteverk (FESIL ASA, 100%)		Ferrosilicon plant at Finnsnes	20
Do.	Oye Smelteverk (Tinfos Jernverk A/S, 100%)		Silicomanganese plant at Kvinesdal	235
Iron, metal	Ulstein Jernstoperi A/S		Hordvikneset	10
Iron ore	Rana Gruber A/S (Norsk Jernverk Holding A/S, 100%)		Mine at Mo i Rana	2,000
Do.	Arctic Bulk Minerals A/S		Mine and plant at Kirkenes	1,500
Lime	Hylla Kalkverk (Nikolai Bruch A/S, 100%)		Verdal/Trondheim Mine and plant	80
Do.	A/S Norsk Jernverk		Plant at Mo i Rana	48
Do.	Ardal og Sunndal Verk A/S		More og Romsdal Mine at Surnadal	20
Do.	Breivik Kalkverk A/S		Alesund Mine at Larsnes	20
Do.	Mjøndalen Kalkfabrik		Plant at Asen/Drammen	7
Limestone	Norcem A/S		Dalen, Bjørntvedt, and Kjøpsvik Mines	1,600
Do.	Vardelskalk A/S (Franzefoss Burk A/S, 100%)		Sandvika Mine	800
Do.	Breivik Kalkverk A/S		Visnes and Glaerum Mines	500
Magnesium	Norsk Hydro A/S (Government, 51%)		Plants at Porsgrunn and Sauda	50
Manganese, alloys	Eramet SA		do.	500
Natural gas	million cubic meters	Den Norske Stats Oljeselskap A/S	Gama, Gullfaks, Sleipner Ost, and Statfjord Fields	12,270
Do.	do.	Phillips Petroleum Company Norway	Ekofisk Field	9,900
Do.	do.	Elf Petroleum Norge A/S	Frigg, Heimdal, and Ost-Frigg Fields	5,750
Do.	do.	Norsk Hydro Produksjon A/S	Troll-Oseberg Field	2,600
Do.	do.	Statoil ASA	Mikkel Field	2,100
Do.	do.	Total, 40%; Petoro, 30%; Marathon Petroleum Norge AS, 20%; and Norsk Hydro Produksjon A/S, 10%	Skirne Field	1,550
Do.	do.	BP Petroleum Development of Norway	Gyda and Ula Fields	1,040
Do.	do.	Esso Norge A/S	Odin Field	1,000
Do.	do.	Amoco Norway A/S	Hod and Valhall Fields	910
Nepheline syenite	North Cape Mineral A/S (Unimin Corp., 84%)		Mine at Stjernoy	350
Nickel:				
Ore, Ni content	Nikkel og Olivin A/S (Outokumpu Oyj, 100%)		Mine at Narvik	3
Do.	Titania A/S (Kronos Norge A/S, 100%)		Mine at Tellnes	0.5
Metal	Nikkelverk A/S (Falconbridge Nickel Mines Ltd., 100%)		Smelter at Kristiansand	85
Olivine	A/S Olivin		Aheim Mine and plant	2,500
Do.	do.		Stranda Mine and plant	300
Do.	Franzefoss Bruk A/S		Lefdal Mine at Brvggia	500

TABLE 2--Continued
NORWAY: STRUCTURE OF THE MINERAL INDUSTRY IN 2004

(Thousand metric tons unless otherwise specified)

Commodity		Major operating companies and major equity owners	Location of main facilities	Annual capacity
Petroleum	42-gallon barrels per day	Den Norske Stats Oljeselskap A/S	Gullfaks, Statfjord, Tommeliten, and Veslefrikk Fields	1,069,300
Do.	do.	Norsk Hydro Produksjon A/S	Brage, Mime, and Oseberg Fields	566,200
Do.	do.	Phillips Petroleum Company Norway	Ekofisk Field	237,500
Do.	do.	Saga Petroleum A/S	Snorre Field	170,000
Do.	do.	BP Petroleum Development of Norway	Gyda and Ula Fields	155,000
Do.	do.	A/S Norske Shell	Draugen Field	90,000
Do.	do.	ExxonMobil Refining & Supply Co.	Slagen Refinery	110,000
Do.	do.	Statoil Mongstad	Mongstad Refinery	200,000
Pyrite		Folldal Verk A/S (Norsulfid A/S, 100%)	Mine at Hjerkind	10
Quartzite		Elkem Tana (Elkem A/S, 100%)	Mine at Tana	540
Do.		Elkem Marnes (Elkem A/S, 100%)	Mine at Sandhornoy	200
Do.		Vatnet Kvarts A/S	Mine at Nordland	150
Do.		Snekkevik Kvartsbrudd	Mine at Kragero	110
Silicon metal		Lilleby Metall A/S (FESIL ASA, 100%)	Plant at Trondheim	9
Do.		FESIL ASA	Plant at Holla	50
Steel		Fundia AB (Norsk Jenverk, 50%; Rautaruukki Group, 50%)	Plants at Christiania, Mandal Stal, Mo i Rana, and Spigerverk	600
Talc		A/S Norwegian Talc (Pluess-Staufer AG, 51%)	Mine/plant at Altermark/Knarrevik and Framfjord	90
Do.		Kvam Minerals A/S	Mine/plant at Kvam	6
Titanium, concentrate		Titania A/S (Kronos Norge A/S, 100%)	Mine at Tellnes	800
Zinc, metal		Norzik A/S (Outokumpu Oyj, 100%)	Smelter at Odda	150